SMD Operations Procedures Manual

8.1.3.21 CRYOGENIC OPERATION OF CABLE TEST DEWAR #6

Text Pages 1 through 8

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Revision 00 Approved:

Signature on File 09/06/02
Division Head Date

Preparer(s): R. Picinich and W. McKeon

8.1.3.21 Cryogenic Operation of Cable Test Dewar #6

1.0 Purpose and Scope

This procedure provides instruction on the following operations of the Cable Test Dewar #6.

- Pump & Purge Cable Test Dewar #6.
- Cooldown to 100 K for Cable Test Dewar #6.
- Cooldown to 4.5 K and 4.5 K Operation for Cable Test Dewar #6.
- Warmup for Cable Test Dewar #6.

2.0 Responsibilities

Operator is responsible for the cryogenic operations associated with testing cable sample in Cable Test Dewar #6.

2.1 After cable sample is installed in the dewar and all cryogenic lines are connected, the operator is responsible for the pump & purge operation to make sure the system is clean and leak tight.

2.2 After pump & purge is completed, the operator is responsible for cooling the dewar including a magnet to 100 K using the liquid nitrogen heat exchanger. Typically, it takes twelve (12) hours to reach 110 K and overnight operation is required.

2.3 After Cable Test Dewar #6 reaches 110 K, the operator is responsible to cool the Cable Sample and Measuring Magnet to 4.5 K using liquid helium. Throughout the test, the operator is responsible for maintaining proper liquid level in the dewar. Since Cable Test demands stable temperature, the operator shall control pressure accurately. Once in a while, the magnet quench. The stored energy is dumped to liquid helium and pressure rises in the dewar. The operator is responsible to cool the system back to the operating condition.

2.4 At the conclusion of the test, the operator is responsible for warming up the system to room temperature using helium flow through the electric heater.

3.0 Prerequisites

3.1 Operator shall be instructed by a supervisor or an authorized operator.

3.2 Instruction shall include the operation of vacuum pumps, liquid nitrogen heat

exchangers, 1000 gallon and 10,000 Liter liquid helium storage dewars and warmup heaters.

3.3 Instruction shall include the computer display page of the Cable Sample Test.

4.0 Precautions

4.1 Transfer liquid helium to magnet test dewar involves pressurizing the liquid storage dewar in use. The operator shall follow the operating procedure not to over pressure the liquid storage dewar.

5.0 Procedure

5.1 Pump & Purge Cable Test Dewar #6

5.1.1 Make sure the supply, return, gauge, air line and all five lines for the current leads are properly connected for Cable Test Dewar 6.

5.1.2 Make sure the insulating vacuum is established.

5.1.3 Make sure valves in the supply header

MOV300M - liquid helium supply,
MOV304M – warmup supply,
MOV305M – transfer line cooldown valve, and
MOV308M – 100 K cooldown supply
are closed.

5.1.4 Make sure valves in the return header

MOV302M – to SULLAIR compressor (subcool return),
MOV303M – to dirty gas bag,
MOV307M – to vacuum pump, and
AOV301M – to warm return
are closed.

5.1.5 Open bottom fill valve AOV311M.

5.1.6 Crack open vacuum pump valve MOV307M to pump on Dewar 6. The vacuum pump is on all the time. Avoid over loading the vacuum pump.

5.1.7 After the pressure decreases somewhat, fully open MOV307M.

5.1.8 The dewar pressure, as shown on PI360M, should reach –30" shortly.

5.1.9 When the pressure is less than 200 micron, on the vacuum gauge VI370M, close MOV307M.

5.1.10 Open MOV302M (subcool) to fill Dewar 6 with clean helium.

5.1.11 When After the 1st pump down, leak check shall be performed for all connections on the top hat of Dewar 6.

5.1.11.1 Close MOV302M.

5.1.11.2 Open MOV304M (warmup) to fill Dewar 6 to 7 psi on PI360D.

5.1.11.3 Use Leak Teck to check all connections.

5.1.12 Repeat steps 4 through 8 three more times.

5.1.13 The pump and purge is completed and Dewar 6 is connected to low pressure clean helium thru MOV302M.

5.2 Cooldown to 100 K for Cable Test Dewar #6

5.2.1 Make sure Cable Test Dewar 6 has been properly pumped and purged.

5.2.2 Make sure valves in the supply header

MOV300M - liquid helium supply,
MOV304M – warm up supply,
MOV305M – transfer line cooldown valve, and
MOV308M – 100 K cool down supply
are closed.

5.2.3 Make sure valves in the return header

MOV303M – to dirty gas bag,
MOV307M – to vacuum pump, and
AOV301M – to warm return
are closed.

5.2.4 Open liquid nitrogen supply valve AOV301N for the LN_2 heat exchanger.

NOTE: Check MOV222 & MOV223 warm helium supply are open.

5.2.5 Wait approximately twenty minutes until the vent line in the LN_2 heat exchanger becomes cold. This ensures liquid nitrogen in the heat exchanger.

5.2.6 Open AOV301M on low pressure return line.

5.2.7 Fully open MOV308M for the helium flow. Use the throttling valve in front of the flow meter for additional flow adjustment. The flow meters should be kept at 25 psi and 8 SCFM.

5.2.8 Watch temperature on the computer for Cable Tests. The temperature will decrease with time. It takes about 12 hours for the magnet assembly in Dewar 6 to reach 100 – 125 K.

5.2.9 Close 100 K cooldown valve MOV308M.

5.2.10 Close liquid nitrogen supply valve AOV301N.

5.3 Cooldown to 4.5K and 4.5 K Operation for Cable Test Dewar #6

5.3.1 After Dewar 6 is cooled to about 100 K, one can proceed 4.5 K cooldown.

5.3.2 Make sure valves in the supply header

MOV300M - liquid helium supply,
MOV304M – warm up supply,
MOV305M – transfer line cooldown valve, and
MOV308M – 100 K cool down supply
are closed.

5.3.3 Make sure valves in the return header

MOV303M – to dirty gas bag,
MOV307M – to vacuum pump, and

MOV302M – to subcool return
are closed.

5.3.4 Set AOV301M, on low pressure return, to 18 psi and AUTO.

5.3.5 Select either Storage Dewar SD 1, 2 or 3 to provide liquid helium.

5.3.5.1 For SD 1 and PAT is running, close return valve HE34 slightly to increase pressure in SD 1 to 7 psi.

5.3.5.2 For SD 1 and PAT is not running, use warm helium to pressure SD 1 to 7 psi by opening H0245M and pressure regulator PR0261. Close HE34 all the way.

5.3.5.3 For SD 2 and HEUB is running, close return valve X1154M slightly to increase pressure in SD 2 to 7 psi.

5.3.5.4 For SD 2 and HEUB is not running, use warm helium to pressure SD 2 to 7 psi by opening H0279M and pressure regulator PR0296. Close X1154M all the way.

5.3.5.5 For SD 3 and HEUB is running, Close return valve X581M slightly to increase pressure in SD 3 to 7 psi.

5.3.5.6 For SD 3 and HEUB is not running, use warm helium to pressure SD 3 to 7 psi by opening pressurizing valve H0334M (the red Hoke valve) and set the pressure regulator. Close X581M all the way.

5.3.6 To get ready for transfer liquid helium to Cable Test Dewar 6, open the helium supply valve on the storage dewar.

5.3.6.1 For Liquid SD 1, open AHE32 and H326M.

5.3.6.2 For Liquid SD 2, open X1220M and H329A.

5.3.6.3 For Liquid SD 3, open X580A and H329A.

5.3.7 Open MOV305M to cool the liquid helium line. When liquid air dripped from the line, close MOV305M.

5.3.8 Open liquid helium supply valve MOV300M to cool Cable Test Dewar 6.

5.3.9 Open bottom fill valve AOV311M.

5.3.9.1 Adjust storage dewar supply valve MOV300M to control the

cooldown from 100 K to 4.5 K. Watch the return pressure and pump back.

5.3.9.2 Open valves for lead flow MOV321M, MOV322M, MOV323M, MOV324M and MOV325M.

5.3.10 On the cable test computer display page, observe temperature readings inside the dewar.

5.3.11 It will take about one and half hours for the temperature inside dewar 6 to reach 4.5 K and liquid level in the lower gauge to occur.

5.3.12 Liquid level in the upper gauges will follow afterward.

5.3.13 Switch the controller of AOV312M to automatic for maintaining constant liquid level in the upper gauge.

5.3.13.1 Close AOV311M bottom fill. Dewar 6 is ready for 4.5 K test.

5.3.14 At the end of the 4.5 K test, close liquid helium supply valve on the selected storage dewar.

5.3.14.1 Close liquid helium supply valve AOV312M.

5.3.14.2 Close valves for lead flow MOV321M, MOV322M, MOV323M, MOV324M and MOV325M.

5.3.15 Vent helium in the cold transfer line and close the cold helium supply valve on selected storage dewar and distribution line.

5.3.15.1 For Liquid SD 1, liquid helium supply valve MOV300M can be closed right away by opening HE37 to vent.

5.3.15.2 For Liquid SD 2 and SD 3, MOV300M open for 30 minutes before closing.
Alternatively if storage dewar is not in use, MOV300M can be closed right away by opening H326M and HE37.

NOTE: In either case, the vent valves shall be opened for about 20 minutes.

5.3.16 Reduce pressure in liquid helium storage dewar to 5 psi.

5.4 Warmup for Cable Test Dewar #6

5.4.1 Make sure valves in the supply header

MOV300M - liquid helium supply,
MOV304M – warm up supply,
MOV305M – transfer line cooldown valve, and
MOV308M – 100 K cool down supply
are closed.

5.4.2 Make sure valves in the return header

MOV303M – to dirty gas bag,
MOV302M – to subcool return, and
MOV307M – to vacuum pump
are closed.

5.4.3 Set AOV301M, on low pressure return, to 18 psi and AUTO.

5.4.4 Slowly open warm up valve MOV304M. The upstream valve MOV306M is preset for normal warm up flow rate. Excessive opening of MOV306M may over pressurize the dewar. If adjustment of MOV306M is required, it must be performed with great care.

5.4.4.1 When setting the warm up flow, you can use the Nullmatic CONTROLLER for valve AOV301M, to help your adjustment on MOV306M

5.4.5 Watch the display page on the computer for Cable Tests. Liquid helium will boil off rapidly. Make sure the boil-off does not upset the compressor system for the refrigerators.

5.4.6 After liquid helium boiled off, turn on the electric heater. The temperature at the exit of the heater should be about 40 C.

5.4.6.1 Open valve MOV302M.

5.4.7 Watch temperature on the computer for Cable Tests. The temperature increases with time. It takes about 12 hours for the Dewar to reach room temperature.

5.4.8 Turn off electrical power to the warm up heater.

5.4.9 Close warm up supply valve MOV304M.

5.4.10 The purpose of warm up is to remove the cable sample. Therefore all supply and return valves must be closed.

5.4.11 Close MOV302M and AOV301M.

5.4.12 Make sure all supply valves and return valves are closed. Vent residual helium from the dewar.

5.4.13 The Cable Sample in Dewar 6 is ready for removal.

6.0 Documentation

6.1 A logbook, in the form of spread sheet, shall be maintained by the operator and kept on the PC in 902 Cryogenic Control Room.

7.0 References

7.1 BNL Drawing, P&I D 902A, Cable Test Dewars, RD 12155434.

7.2 BNL Drawing, P&I D 902A, Liquid Helium Storage Area, RD 12155451.

8.0 Attachments

None